Multidimensional Performance in Telecommunications, Regulation and Competition: Analysing the European Major Players

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December 1998

Abstract

In this paper we adopt the methodology developed by Banker et al. (1993) in order to investigate the dynamics of the different components of performance for the major European telecommunications operators during the period 1989-1993. The results show a general improvement in productivity levels and a reduction in the ratio between output and input prices. The best productivity performances were attained by the British and (to a lesser degree) the French utilities, while only British Telecommunications was remarkably reducing output prices. These findings are consistent with the view that incentive regulation is useful to enhance efficiency but the introduction and the promotion of competition seems to be more effective in reducing the price levels.

Keywords: Telecommunications, Performance, Regulation.

JEL: L96, M40

We would like to thank A. Sembenelli and the participants to a seminar held at CNR, Rome for helpful comments and suggestions. Special thanks also to STET for helping us with the data collection.

1. Introduction

Notwithstanding in the last decade the European telecommunications industry has been characterised with strong pushes towards liberalisation, a limited number of countries has effectively directed towards privatisation or the introduction of more competitive conditions. This is a period of transition with different realities as far as market structure, regulatory practises, tariffs and ownership structure are concerned: true competition is still very limited in the fixed telephone market and only recently has been introduced in the mobile market, and regulatory practises range from cost based rules to price cap mechanisms. Comparing the performances of the main operators might be useful for evaluating which path is worthwhile to be followed.

The empirical literature in this area concentrates generally on the analysis of single components of global performance. The studies address different issues such as the efficiency of operators, the technical progress, the effects of different regulatory mechanisms, or the role of ownership structure and competition. A common drawback is that the real components of productivity are not associated with input and output price movements in a unified framework.

In the present work we compare the performance of the main telecommunications utilities in France, Germany, the United Kingdom, Italy and Spain, by disaggregating a profitability (revenue/cost) change ratio in four components. The latter check for productivity changes, price variations, product mix changes and capacity utilisation changes. We will try to assess the role of incentive regulation and market structure in determining the performance levels.

Section 2 offers a critical review of the literature on the economics of the telecommunications industry and a contribution to the debate between regulation and liberalisation. In section 3 the main characteristics of the industries are sketched for the different countries. Section 4 develops the methodology which has been used while section 5 presents and comments upon our main results. Section 6 summarises.

2. Natural monopolies, regulation, privatisation and competition

2.1 From natural monopoly towards competition

In most European countries privatisation programmes have been announced and, up to a certain extent, partially accomplished in telecommunications. The process is still very slow but the prevalent economical and political view is to reinforce it. The

nationalisation of the telecommunications industry in the early stages of its development has been justified on the grounds that conditions of natural monopoly prevail. If average costs are everywhere decreasing or if the minimum efficient scale (MES) is high if compared to the level of demand, efficiency considerations would require the presence of a single monopolist in the provision of the service. Exogenous increases in the level of demand and improvements on the technology shift the demand and the average cost curves, and in the new situation there may be room for two or more firms. Since both technology and demand have evolved in the telecommunications industry, many authors began to argue that the natural monopoly argument was flawed (Viscusi et. al, 1994). This is certainly uncontestable in the long distance market (Intercity Telecommunication Market, or ITM, in the United States), but is more debatable in the local telephone market[1] (Armstrong, 1997).

Assuming that the monopoly is not justified anymore, the State may follow different paths in order to reach its objectives, which are broadly summarised by a widespread and high quality provision of the telecommunication service at the lowest prices. Should the Government regulate the industry in order to counterbalance the effects of some remaining market failures or should it deregulate, promoting entry and competition? Should it preserve the ownership of dominant firms or should it direct towards privatisation?

As to the first question, Trebing (1989) argues that entry barriers are not likely to be high in such a growing and technologically dynamic market. However, the telecommunications industry may not be considered as a contestable market because of the high sunk costs which render the textbook 'hit and run' strategy unfeasible. Laffont, Rey and Tirole (1997) point out that a liberalisation of an industry which is not mature enough and is still dominated by a small number of firms might stimulate and facilitate anticompetitive practises such as collusive behaviour and entry deterrence. Armstrong (1997) argues that, due to the presence of fixed connection costs, each premise will rather be connected to one network. That network will then enjoy monopoly power even

[1] The recent developments of the digital switching technology and the innovations in the cellular telephony point to consider also the local telephone market (LTM) as a unnatural monopoly. At present, however, cellular systems are used to communicate principally with wire-based systems, so that the situation of local monopoly is likely to persist in the near future (Greenwald and Sharkey, 1989). Even in a context of wire-based networks, however, Shin and Ying (1992) found that for a sample of US local exchange carriers (LECs) the cost function was not subadditive. They concluded that the breaking up of LECs would generate cost savings.

if the number of competing networks is high. He concludes then that "regulation will continue to play an important role in the industry for the foreseeable future".

On the other side, Schankerman (1996) and Knieps (1997) believe that the adoption of symmetric regulatory rules is the route to be followed, since "all forms of asymmetric regulation contain an intrinsic bias towards some firms or technologies and run the risk of imposing large productive efficiency costs". Similarly, Bognetti and Fazioli (1997) argue that conduct regulation, that is the regulation at the national level of a particular firm (which is generally a monopolist) should be replaced by a structural regulation at the European level.

These two strands are also present in Cave's paper (1997). He argues that, if competition is guaranteed, specific regulatory practises for telecommunication operators (such as regulation of prices and entry conditions) might be eliminated in favour of a regulation under the antitrust law, following which each behaviour is permitted, provided that it is not specifically forbidden (normalised regulation)[2].

The second question implies a digression on the relative efficiency of State owned and privately owned firms in managing a particular business in general, and the telecommunications service in particular. The literature suggests many efficiency advantages of private ownership (capital market monitoring, risk of bankruptcy, well defined objectives, etc.). A relevant issue for the telecommunications industry is however the comparison between a State owned firm and a private *regulated* firm. Following Laffont and Tirole (1993), through nationalisation the State may have external and internal control on firm's activities, while only external control remains with a regulated private firm and no control at all with unregulated private firms[3]. As far as incentives to managers are concerned, a regulated private firm is inefficient in that there is a duplication of constraints: the regulatory body imposes constraints directly on the firm and indirectly on the managers, while the shareholders impose constraints directly on the managers: the latter are then more prone to exert lower levels of effort. However, in a publicly owned firm managers' investments may be expropriated ex post

[2] The author argues that the UK is evolving towards a normalised regulation, since the regulators are reducing the efficiency improvements included in the price-cap formulas and the percentage of sales of telecommunication operators subject to control. As to effectiveness of such a policy, however, he is more cautious, because "it is by no means certain that competition will be 'effective'".

[3] External control refers to the possibility of regulating prices, quality, entry, access pricing, while internal control is the control over firm's inputs, managerial incentives, investment levels, the number of employees, etc.

and directed towards uses which are different from those foreseen ex ante, so managers may be well induced to exert a low level of effort.

As far as the empirical literature is concerned, results on the effects coming from privatisation are ambiguous. Hartley et al. (1991) found improvements in the performance of 10 big British firms[4] after privatisation. The same results emerge also from an empirical investigation on small and medium sized Italian firms (Fraquelli and Fabbri, 1997) which have been privatised in the 80's. On the other side, starting from the theoretical and empirical work of Yarrow (1986), many scholars showed some doubts on the positive effects of a change of property *tout-court*. In particular, the analysis of productivity is favourable to private ownership in competitive markets whereas for industries characterised by conditions of natural monopoly a tight regulation appears to be an optimal second best solution.

2.2. Regulation and Incentives

The price system of a public service should be oriented to balance the well known objectives of efficiency and equity: in other words it should keep an eye on the waste of public resources, while with the other it should allow a fair distribution of the firm's allowed revenue among the beneficiaries of the service. Price regulation might be classified in two broad categories: social contracts or price caps on the one hand and rate of return or cost reimbursement schemes on the other.

Rate of return regulation has the primary goal of approaching the theoretical results of competition, where costs and revenues equate each other. Consumers bear the risks of cost increases and enjoy the benefits of cost reductions. In such an environment it could be easier for firms to meet good quality requirements and to undertake some innovative but risky investments. On the other hand, many authors starting from the work of Averch and Johnson (1962) have stressed some inefficiencies of rate of return regulation, on the grounds that it can induce a misallocation of resources. The "A-J effect" suggests that if the allowed rate of return exceeds the correct remuneration of capital firms will overinvest in capital[5].

[4] Their sample comprehends also some firms still subject to state ownership but characterised by interventions towards privatisation

[5] Moreover, a diversified firm operating both in a competitive and in a monopoly market, under profit level regulation on the combined markets might have a long run incentive to price below the long run marginal cost in the competitive market, while raising prices in the monopoly market. Potential entrants might then find it difficult to enter the competitive market (Doyle, 1994).

Price cap regulation is based on direct price constraints and could more effectively replace the indirect rate of return regulation. Under price level regulation the allowed revenues are not linked to the internal costs anymore and firms are pushed to minimise costs. However, some drawbacks have to be pointed out. First, risks of increases in costs are to be borne by the firm, which may be reluctant towards new innovative investments[6]. Second, it becomes more difficult to support unprofitable but socially desirable strategies such as a complete coverage in the service, unless this constraint is not directly imposed in the regulatory scheme.

Braeutigam and Panzar (1993) argue that a potentially competitive market may be well regulated through price caps. This is a second best strategy and should be considered as transitory in the process of deregulation and liberalisation. In natural monopolies, however, the advantages of price caps over other forms of price regulation (rate of return regulation or hybrid methods) are less clear cut.

2.3. The effects on the performance of Telecommunications operators

In the previous sub-sections we discussed in general terms the pros and cons of privatisation, regulation and liberalisation in a market such as that of telecommunications services. A particular intervention influences firms' incentives in a specific direction, and this in turn generates different expectations as far as firms' performance, market structure and prices to the final consumer are concerned. When one passes from the theory to the empirical analysis, a number of problems arise. This point is made for example by Kridel et al (1996). In their review of the effectiveness of incentive regulation in the telecommunications industry they point out that it is extremely difficult to disentangle the effects of regulation from the ones coming from privatisation and competition as far as performance, quality in the service, productivity, investments, prices and innovation are concerned. Our study is not an exception to this. However, as it will be made clear in the next section, by disentangling the different components of profitability, we are able to check simultaneously for four dimensions of firm's performance (productivity, price recovery, capacity utilisation and product mix). Since our firms operate in partially different market and regulatory contexts, the

[6] Solimene (1995) found that for British Telecom price caps had the effect of rationalising, instead of reducing, long run investments in R&D.

dynamics of their performance results will be put in relation with the incentive regulation and market structure they have to face.

3. The principal European players and the structure of competition

While in the future deregulation and liberalisation might prevail, regulation and a gradual introduction of more competition appear to be more feasible short term realities in Europe, given the high interests at play in the telecommunications market. "Experience in many countries shows that the devil is in the details and that competition does not arrive overnight" (Waverman and Sirel, 1997). Table 1 (elaborated from the data included in Levington, 1997) summarises the situation of the industry in 1994, highlighting some broad differences between firms as far as private ownership, regulation and the degree of competition are concerned.

We are confident that the firms examined in our study during the period 1989-93 represent fairly the whole telecommunications markets in their respective countries. This is certainly true for France Telecom (FT) and Telefonica (TS). The former was operating as a vertically integrated monopoly. The latter has been a monopolist up to 1992, when the Spanish government started a process of deverticalisation by withdrawing some lines of business and by opening the mobile market and the provision of value added services to other operators. As far as Deutsche Telekom (DT) and Telecom Italia (TI) are concerned, the monopolistic situation is slightly counterbalanced by some competition in the value added services (VAS) and by the presence of a second operator in the mobile market after 1989[7]. Finally, notwithstanding British Telecommunications (BT) was privatised in 1984 and put in competition with Mercury, it has always enjoyed a position of relative strength[8].

In short, the monopolistic structures are still well widespread everywhere with the exception of the UK which appears to be the only country with a competitive environment[9]. The price regulation is however more differentiated. In the UK entry conditions, access prices and telephone tariffs have been regulated since the

[7] The competition in the mobile market was however limited in that the new companies were in the earlier stages of their activity.

[8] BT does not cover the whole market for the examined period, but its weight and market power are still very strong.

[9] However, it should be pointed out that presence on the British market of two operators started to produce its effects only in the latest years. The gradual strengthening of Mercury led competition in the long distance and in the international telecommunication markets.

privatisation of BT. OFTEL is a regulatory institution independent from the government appointed to monitor prices on the basis of a price cap mechanism. France is oriented to the control of efficiency through price ceilings too[10]. Conversely, Italy, Spain and Germany are characterised by price controls based on the recovery of costs. Since the former two have known a great development in the diffusion of traditional services during the 80's, a rate of return type regulation certainly facilitated investments but might have had negative repercussions on productivity growth. Finally, in the German market the unification in 1990 led to the restructuring of the industry with massive investments.

4. The methodology: four components of performance

A traditional measure of firm's financial performance is the ratio between operating profits and assets[11] (return on investments, or ROI) which can be usefully decomposed as follows:

$$ROI = \frac{\text{Operating Profit}}{\text{Sales}} \cdot \frac{\text{Sales}}{\text{Assets}} \qquad [1]$$

The left term of the right hand side is the return on sales (ROS), while the right term is an index of the turnover of assets. The ROS ratio might be expressed as:

$$ROS = 1 - \frac{\text{Sales - Operating Profits}}{\text{Sales}} = 1 - \Pi^{-1} \qquad [2]$$

where Π=sales/operating costs is an index of profitability measured on costs (revenue-cost ratio) which can be compared in different periods. If we eliminate the effects of changes in input and output prices, Π is useful as an index of productivity. By comparing Π in two periods it is possible to examine separately the effects of changes in prices, the quantities being constant, or the variations in productivity, the prices being constant. This is the approach followed by the American Productivity Center (APC, 1981). Banker et al. (1993) extended the APC method by disaggregating the Π ratio in

[10] The French model is particularly interesting in that it foresees a contract of programme between the government and FT. Some efficiency and quality targets are defined, such as a yearly reduction of 3% in real tariffs for the period 1991-1994.

[11] Fisher and McGowan (1983), among others, criticises the use of accounting measures for inferring something about economic rates of returns. For a discussion, see Wilson (1992).

four components. The above development provides the analyst with a richer set of information: a firm might be profitable due to higher prices, or because it is very efficient in activating inputs or in choosing the product mix, or because it has not overinvested in capacity.

Let us define:

Y^t_i, the quantity of output i in period t, i=1,...,n;

p^t_i, the price of output i in period t, i=1,....,n;

X^t_V, the quantity of the variable input v in period t, v=1,....,m;

w^t_V, the price of the variable input v in period t, v=1,.....,m;

X^t_F, the quantity of the fixed input F in period t, F=1,...,g;

w^t_F, the price of the fixed input F in period t, F=1,....,g;

Π^t, the ratio between sales and costs in period t;

The revenue-cost index in period t (Π^t) will be:

$$\Pi^t = \sum_i Y_i^t p_i^t \Big/ \left(\sum_V X_V^t w_V^t + \sum_F X_F^t w_F^t \right) \qquad [3]$$

and its variation (RCCR) between t and t_0 will be:

$$RCCR = \Pi^t / \Pi^0 = \frac{\sum Y_i^t p_i^t \Big/ \left(\sum_V X_V^t w_V^t + \sum_F X_F^t w_F^t \right)}{\sum Y_i^0 p_i^0 \Big/ \left(\sum_V X_V^0 w_V^0 + \sum_F X_F^0 w_F^0 \right)} \qquad [4]$$

Since we are interested in comparing the performance of different firms in the period 1989-1993 we need for each firm an index of relative performance. The benchmark (period t=0) in principle could be a firm with some particular characteristics or simply a hypothetical firm with outputs, inputs and prices corresponding to the average values of the examined firms. The relative position of each firm with respect to the average firm and the evolution upon time of its performance can then be analysed. For each component of the revenue cost change ratio (RCCR) the results achieved by each single firm will be therefore compared with some standard values. The four components of RCCR and the standardisation procedures are as follows[12]:

[12] For more details on the methodology, see Banker et al. (1993 and 1996).

a) Productivity ratio (TFP)

A higher productivity level in period t occurs when, by applying standard inputs (Q^t_V and Q^t_F) instead of actual inputs (X^t_V and X^t_F) an increase in the costs would result.

$$\text{TFP} = \frac{\left(\sum_V w^t_V Q^t_V + \sum_F w^t_F Q^t_F\right)}{\left(\sum_V w^t_V X^t_V + \sum_F w^t_F X^t_F\right)} \qquad [5]$$

The standard variable input needed in period t (Q^t_V) is obtained by multiplying the standard input requirement α_{vi} per unit of output by the quantity produced in period t[13].

$$Q^t_V = \sum_i \alpha_{Vi} \cdot Y^t_i; \quad where \quad \alpha_{Vi} \geq 0 \ and \quad Y^t_i \geq 0 \qquad [6]$$

The standard quantity of fixed inputs per period t (Q^t_F) is obtained by multiplying the standard fixed input requirement per unity of capacity β_F by the actual capacity activated in period t[14]: $Q^t_F = \beta_F \, CAP^t$;

b) Price recovery ratio (PRREC).

The index highlights the impact on profitability of variations in relative prices. The output quantities are held constant at the actual level and the input requirements are held constant at the standard levels defined above[15].

$$\text{PRREC} = \frac{\sum_i p^t_i Y^t_i \,/ \left(\sum_V w^t_V Q^t_V + \sum_F w^t_F Q^t_F\right)}{\sum_i p^0_i Y^t_i \,/ \left(\sum_V w^0_V Q^t_V + \sum_F w^0_F Q^t_F\right)} \qquad [7]$$

c) Product Mix (PRMIX)

[13] Proxies for the coefficients α_{vi} are obtained by regressing the physical quantity of the variable input (for the pooled sample of observations across time periods and across firms) on the physical quantities of the different outputs Y^t_i. If the input v is used to produce a single output i, the sum in [6] disappears and $Q^t_V = \alpha_{vi} \cdot Y^t_i$.

[14] β_F is obtained by dividing the average level of fixed inputs across time periods and across firms by the average level of capacity.

[15] The standard prices p^o_i, w^o_v and w^o_F , as well as the standard quantities X^o_V, X^o_F and Y^o_i , are average values across time periods and across firms.

In order to individualise changes in the product mix, fixed inputs are considered at standard input requirements as well as at standard levels of capacity, while variable inputs are still kept at standard quantities:

$$\text{PRMIX} = \frac{\sum_i p_i^0 Y_i^t \Big/ \left(\sum_V w_V^0 Q_V^t + \sum_F w_F^0 G_F^t\right)}{\sum_i p_i^0 Y_i^0 \Big/ \left(\sum_V w_V^0 Q_V^0 + \sum_F w_F^0 G_F^0\right)} \qquad [8]$$

While Q^t_F assumes standard fixed input requirements and allows for capacity to vary, G^t_F assumes a standard level of capacity: $G^t_F = \beta_F \mu^t$, where μ^t is the standard capacity required for producing $\sum Y_i^t$.

d)Variations in capacity utilization (CAP)

If we hold standard input requirements α_{vi} and β_F and compare fixed inputs at standard capacity requirements (G^t_F) with fixed inputs at actual capacity (Q^t_F) we have an index of the variation in capacity utilization:

$$\text{CAP} = \frac{\sum_V w_V^0 Q_V^t + \sum_F w_F^0 G_F^t}{\sum_V w_V^0 Q_V^t + \sum_F w_F^0 Q_F^t} \qquad [9]$$

By multiplying the four indices above we obtain the revenue/cost change ratio in [4]. To be more specific, we obtain:

$$\frac{\sum Y_i^t p_i^t \Big/ \left(\sum_V X_V^t w_V^t + \sum_F X_F^t w_F^t\right)}{\sum Y_i^0 p_i^0 \Big/ \left(\sum_V Q_V^0 w_V^0 + \sum_F G_F^0 w_F^0\right)} \qquad [10]$$

Since we are using t=0 as a benchmark, standard and actual values when t=0 coincide. Thus, $Q_V^0 = X_V^0$ and $Q_F^0 = G_F^0 = X_F^0$ and expression [10] reduces exactly to equation [4].

The advantages of the disaggregation in four indices as compared to the traditional APC method are apparent: the latter is able only to detect a productivity change ratio and a price recovery ratio. In fact, following the APC method, equation [4] is decomposed in:

$$\text{RCCR}=\frac{\sum_i p_i^0 Y_i^t \Big/ \left(\sum_V w_V^t X_V^t + \sum_F w_F^t X_F^t\right)}{\sum_i p_i^0 Y_i^0 \Big/ \left(\sum_V w_V^t X_V^0 + \sum_F w_F^t X_F^0\right)} \bullet \frac{\sum_i p_i^t Y_i^t \Big/ \left(\sum_V w_V^t X_V^0 + \sum_F w_F^t X_F^0\right)}{\sum_i p_i^0 Y_i^t \Big/ \left(\sum_V w_V^0 X_V^0 + \sum_F w_F^0 X_F^0\right)}$$

The first term is and index of productivity change, while the second term is an index of price recovery change. The richness of the method used in this investigation is to separate the pure effects of price and productivity changes from changes in capacity utilisation and in the product mix[16].

5. The empirical investigation

Table 2 records some data on our sample firms. Several differences should be stressed before starting the empirical analysis. TI and TS started a catching up process during the eighties while Germany was forced to restructure the telecommunications industry after the reunification. This is clearly reflected in the high levels of some indices: fixed assets per main lines, investment/sales ratio, growth rate of main lines and growth rate of sales. Moreover, since Italy has the highest cost of labour, TI tried to save on the number of employees. This is confirmed in the ratios sales/employees and main lines/employees[17]. As far as performance is concerned, the ROI index highlights the optimal position of BT as compared to the other four firms. However, by looking at the gross operating income/invested capital ratio[18] different indications emerge. It appears that depreciation and the nature of new investments do play an important role on firms' performance. As we will show, similar levels of profitability may well origin from very different operational conditions. It turns out that a careful comparison between companies cannot rely only upon a quick analysis of a few number of indices. Moreover, the analysis which follows is particularly apt to investigate the dynamic aspects of the various components of performance.

5.1. The data base

In the construction of the RCCR index we consider one variable cost input (external costs, a category which groups raw materials, other operating costs, payment

[16] For applications of the APC method, see Banker et al (1996) and Fraquelli and Vannoni (1999).

[17] A reduced number of workers could imply also a different degree of vertical integration or lower levels of quality in the service (percentage of public telephones out of work, average waiting time for the installation of new lines, percentage of technical faults, etc.)

[18] The gross operating income is the difference between sales and the sum of external costs and labour costs, and is not including depreciation costs.

to telephone operators, supply and other services) and two fixed cost inputs (depreciation and labour). Sales are disaggregated in three categories: monthly subscription, telephone sales and other sales. After having deflated and converted to the Italian currency (by applying an average exchange rate) the figures drawn from the balance sheets, the revenue cost ratios are constructed by dividing the aggregated sales by the sum of variable and fixed input costs. In order to obtain prices for inputs and outputs we need to divide revenues and costs by some measures of physical outputs and physical inputs. Physical outputs which have been used are telephone calls for telephone sales and number of main lines for monthly subscription and for other sales[19]. The number of employees has been used as the physical input for labour costs and for external costs and the number of main lines as a physical input for depreciation and as an index of capacity.

5.2 The results

As far as the revenue/cost change ratio is concerned the data in table 3 show a process of convergence with a initial range of 0.81-1.22 which reduces to 0.97-1.04. TI, BT and TS increased their profitability, while DT reduced it and FT showed a stable pattern. Capacity utilisation and productivity change are responsible for the profitability result of Italy while increased productivity counterbalanced by lower price recovery indices explain the weak increases of Spain and the UK and the decreasing pattern for Germany.

As to price recovery, TI seems to be the only firm without a decreasing pattern. The index may be decomposed in output price changes and input price changes. By looking at table 4, the firm which appears to have most intensively reduced prices is BT, followed with DT and, to a lesser extent, by FT. The large decrease in the price recovery ratio is in fact partly due to the increase in input prices. A particular case is Italy, where the change in the price recovery index is due to an effort for reducing input prices, while output prices remain basically constant. Turning to the other ratios, it appears that all firms have directed towards a slight increase in capacity utilisation and

[19] Banker et al (1998) argue that 'the deployment of lines is not under management control since they have to be supplied on demand to various customers at prices which are regulated for certain customer categories', and suggest that lines may well be considered as an output.

towards a higher level of productivity[20], while for the change in the product mix the positive effects are limited to TS, DT, and TI.

Figure 1 plots the average values of the indices across firms. It is possible to notice that in the 1989-1993 period the telecommunications operators increased productivity and, to a much lesser extent, capacity utilisation, while they reduced the price recovery ratio. Finally, the product mix change ratio did not change. These outcomes are overall consistent with the results one would expect in view of a more dynamic and competitive environment. As far as the performances of the single firms are concerned table 5 highlights that BT has been characterised with the highest improvements in productivity (47%, followed by FT and DT at 12% and by TI and TS at 9%). Moreover, table 5 reveals that only BT has reduced the level of output prices to a great extent (17% of decrease in the index for BT as compared to -9% for DT and -3% for FT).

A first look at the productivity results seems to suggest that the different incentive price regulations characterising the telecommunications industries in the five European countries examined here have not bring significant differences. However, as we will argue below, the price-cap mechanisms in the UK and in France may well have been important in stimulating efficiency improvements. The higher level of competition in the UK and the private ownership, on the other side, seem to be reflected in the excellent performance of BT, as far as productivity improvements and output price change are concerned.

5.3. Robustness

We have tried different variants to the basic model discussed in section 5.1. First, instead of using the number of calls, we tried an alternative measure of the physical output for *telephone sales*, and namely the total number of minutes[21], while the total number of main lines was still the physical output for *monthly subscription* and *other sales*. Second, we used the geometric average of calls (or minutes) and lines as the physical output for other sales. This has been done since, differently from the case of

[20] The absolute level of productivity for TI is very high, and this is certainly influenced by the relatively fewer number of workers.

[21] While the total number of calls was available for all 5 firms (even if for TS it was not available for all the years) data on the total number of minutes were available only for TI and FT. Total number of minutes for the other three firms have been imputed by assuming that they shared for each year the average number of minutes per main line of TI and FT.

monthly subscriptions, which are unequivocally linked to the number of main lines, under the label 'other sales' are grouped a set of non homogeneous revenues such as equipment supply, directory and books, data and fac-simile transmission, cable TV, other services to consumers, and so on. Most of them are linked to the number of access lines, but some items are probably connected to the number of calls. The results are robust to different assumptions about the relative weights of calls (or minutes) and lines in explaining our three main categories of sales. Finally, we tried also to vary the exchange rates chosen to normalise the balance sheets values, and again no significant changes have been detected.

5.4. An assessment

Staranczack et al (1994) conducted a study on the productivity growth of the telecommunications industries in a sample of 10 OECD countries for the period 1984-1987. They found that productivity growth was determined mainly by output growth and by the private ownership of firms, while the variables controlling for the degree of competition and for technological change were found to be unimportant[22]. Considering our sample, DT was interested by the highest output growth (12.8% in term of number of calls), followed by TS (8.6%), TI (8%), FT (7%) and BT (2.6%)[23]. The increase in the output sold cannot then provide a satisfactory explanation for the high productivity performances obtained by BT and FT (see table 3)[24]. Instead, it seems that the incentive regulation activated in France and in the UK played a positive role.

Banker et al (1995) found patterns similar to our results for the US telecommunication operators in the period 1988-91, except from the capacity utilisation index, which was found to be practically constant. However, in the period 1981-87, their sample of firms had increased both the capacity utilisation and the product mix indices. Following liberalisation, firms should concentrate on segments for which high price-cost margins are expected, but a successive introduction of more competition may reduce the price cost margins for all services. Thus, firms cannot increase the average profitability by changing the product mix. Our results for this variable resemble the ones reached by Banker et al (1995) for the 1989-91 sample. As far as capacity utilisation is concerned,

[22] The authors did not include a variable checking for the effects of different regulatory practises.
[23] The same low levels for FT and BT are evidenced in table 2 with reference to the growth rate of sales.
[24] Output growth could explain however the high change in productivity recorded by DT.

one should expect an increase in the index. The upward trend of CAP might suggest that some firms are possibly reverting an Averch-Johnson type effect. However, the weak increase could reflect also strategic plans of firms to restructure their networks in view of the future tougher competition at the international level, so that the pressure on capacity utilisation is accordingly reduced.

It is also interesting to compare the methodology developed by Banker et al (1993) with the traditional APC method. Since the product mix ratio does not vary and the capacity utilisation increases only slightly, the two approaches in this case give similar results, as can be easily seen from Figure 2. The only noticeable difference is that productivity changes with the APC method are overestimated when CAP is higher than one and underestimated when CAP is lower than one (see figure 1).

6. Conclusions

In the paper it is argued that the information coming from a single component of profitability of telecommunications operators (productivity, price dynamics) is inadequate in order to investigate issues such as the importance of competition and the impact of different regulatory practises.

The European leaders showed similar profitability change ratios in 1993 together with a general improvement in productivity and in the capacity utilisation change ratio in the period 1989-1993. The ratio between output and input prices decreased as well. The firms however behaved differently: BT directed towards a significant reduction in output prices while the productivity improvements of DT and, in a particular way, of FT were accompanied by an increase in inputs prices and by a limited reduction in output prices. The disaggregation of data proposed in the paper, which allows for a more rich treatment than the one suggested by the APC methodology, is useful for analysing the trade off between regulation and competition. The good dynamics of the productivity change ratios, associated with the trend of demand growth, is stressing the good results of BT and FT. The latter are both operating in countries characterised by similar regulatory rules but they differ significantly as far as the structure of competition is concerned. A deeper look at the components of the price recovery ratio suggests that, while a different regulatory regime is able to influence the productivity, a higher level of competition seems to be the only way for a strong reduction of prices to the benefit of the final consumer.

References

American Productivity Center (1981). Total Productivity Measurement, (Houston, TX).

M. Armstrong (1997). Competition in Telecommunications, Oxford Review of Economic Policy, 13, 64-82.

H. Averch and L. Johnson (1962). Behavior of the firm under regulatory constraint, American Economic Review, 52, 1052-1069.

R.D. Banker, H.H. Chang, S.K. Majumdar (1993). Analyzing the Underlying Dimensions of Firm Profitability, Managerial and Decision Economics, 14, 25-36.

R.D. Banker, H.H. Chang, S.K. Majumdar (1995). The consequences of evolving competition on the components of firms' profits: recent evidence from the US telecommunications industry, Information Economics and Policy, 7, 37-56.

R.D. Banker, H.H. Chang, S.K. Majumdar (1996). A Framework for Analyzing Changes in Strategic Performance, Strategic Management Journal, 17,693-712.

R.D. Banker, H.H. Chang, S.K. Majumdar (1996). Profitability, Productivity and Price Recovery Patterns in the US Telecommunications Industry, Review of Industrial Organisation, 11, 1, 1-17.

R.D. Banker, H.H. Chang, S.K. Majumdar (1998). Economies of scope in the U.S. telecommunications industry, Information Economics and Policy, 10, 2, 253-72.

G. Bognetti and R. Fazioli (1997). The end of national public monopolies and the problem of European regulation in TLC, The Regulation of Telecommunications, Quaderno G. Prato n.31, University of Turin.

R. Braeutigam and J. Panzar (1993). Effects of the change from rate of return regulation to price cap regulation, American Economic Review, 83, 191-198.

M. Cave (1997). The evolution of Telecommunications Regulation in the UK, European Economic Review, 41, 691-699.

C. Doyle (1994). Some efficiency aspects of price regulation, mimeo, II Meeting of the Utilities Regulation Network, Prague.

F.M. Fisher and J.J. McGowan (1983). On the misuse of accounting rates of return to infer monopoly profits, American Economic Review, 73,1, 82-97.

G. Fraquelli and P. Fabbri (1997). Privatisation and economic performance of Italian firms, mimeo, Ceris-CNR, Turin.

G. Fraquelli and D. Vannoni (1999). Competizione e regolamentazione nei servizi di telecomunicazione. Redditività, produttività e prezzi dei principali gestori europei, in: L. Paganetto (ed), Istituzioni e governo dell'economia, Il Mulino.

H.B. Greenwald and W. Sharkey (1989). The economics of deregulation of local exchange Telecommunications, Journal of Regulatory Economics, 1, 319-339.

K. Hartley, D. Parker, S. Martin (1991). Organisational status, ownership and productivity, Fiscal Studies.

G. Knieps (1997) Phasing out Sector-Specific Regulation in Competitive Telecomunnications, Kyklos, 50, 3, 325-339.

H. D. Kridel, D. Sappington, D. Weisman (1996). The effects of incentive regulation in the telecommunications industry: a survey, Journal of Regulatory Economics, 9, 269-306.

J.J. Laffont and J. Tirole (1993). A theory of incentives in procurement and regulation, The MIT Press.

J.J. Laffont, P. Rey and J. Tirole (1997). Competition between telecommunications operators, European Economic Review, 41, 701-711.

I. Lewington (1997). Utility Regulation: Economic regulation of utilities and network industries worldwide, Privatisation International Publications, London.

M. Schankerman (1996) Symmetric regulation for competitive telecommunications, Information Economics and Policy, 8, 3-23.

N. R. Shin and J.Ying (1992). Unnatural Monopolies in Local Telephone, Rand Journal of Economics, 23, 171-183.

L. Solimene (1995). Regolamentazione ed incentivi all'innovazione nel settore delle telecomunicazioni, Quaderni dell'Istituto di Economia dell'Impresa e del Lavoro, n. 11, Università Cattolica del Sacro Cuore, Milano.

G. Staranczack, P. Sepulveda, P. Dilworth, S. Shaikh (1994). Industry structure, productivity and international competitiveness: the case of telecommunications, Information Economics and Policy, 6, 121-142.

H.M. Trebing (1989). Telecommunications Regulation- The continuing Dilemma, ch. 4 in K. Nowotny, D. Smith, H.M. Trebing, Public Utility Regulation, Kluwer Academic Publishers.

W. Viscusi, J. Vernon, J. Harrington (1995). Economics of Regulation and Antitrust, the MIT Press.

L. Waverman, E. Sirel (1997). European Telecommunications Markets on the verge of Full Liberalization, Journal of Economic Perspectives, 11, 4, 113-126.

T. A. Wilson (1992). An analysis of the profitability of businesses of diversified companies, Review of Industrial Organisation, 7, 151-85.

G. Yarrow (1986). Privatisation in theory and practise, Economic Policy, 2, 323-377.

Table 1 - Comparative Utility Regulation (situation until 1994)

	France	Germany	Italy	Spain	UK
Industry structure	Vertically integrated monopoly	Monopoly in fixed networks VAS and customer premises equipment are free	Monopoly in fixed and Duopoly in Mobile networks. VAS and transmission are free	Monopoly in fixed and mobile networks Data transmission and VAS are free	Duopoly till 1991 From 1991 the market is fully liberalised Incumbent's (BT) market dominance remains strong
Companies involved	France Telecom	Deutsche Bundespost Telekom	STET (holding) Telecom Italia Telecom Italia Mobile Omnitel Pronto Italia	Telefonica	British Telecommunications Mercury Jonica Energis (1994) Cable companies
Ownership	State firm	Public enterprise part of federal administration	The only private firm is O.P.I.	Private firm (30% of State ownership)	Private firms
Competition	Fixed networks: absent VAS and mobile networks: very low	Fixed networks: absent VAS and mobile networks: yes	Fixed networks: absent Mobile networks: very low	Fixed and mobile networks: absent VAS: yes	At the local level: low Long distance and international markets: increasing VAS: yes
Price regulation	Planning contract with a price cap regulation. 3% red. of tariffs in real terms (1991-94)	Cost based Regulation	Cost based approved by the Government	Cost based approved by the Government	Price cap on a weighted basket of services

Table 2 - The major EU players (values expressed in Italian liras)

	Telecom It.	*British Telecom*	*France Telecom*	*Deutsche Telekom*	*Telefonica*
Sales 1994*	29100	33546	30715	44954	16635
(Yearly growth rate 1989-1994)	(10.7%)	(2.4%)	(6.3%)	(9.8%)	(12.4%)
Employees 1994	96815	148500	152568	225400	73274
Main Lines 1994**	24542	27201	31600	39200	14685
(Yearly growth rate 1989-1994)	(2%)	(1.7%)	(3%)	(6%)	(4.4%)
ROI (average 89-94)	9.3%	21.7%	13%	10.2%	10%
Gross operating income / Invested capital (av. 89-92)	33.2%	33.7%	28.2%	25.2%	20.6%
Sales / main lines ** (1994)	1087	1159	950	1102	1102
Sales / employees ** (1994)	304000	226000	201000	199000	227000
Lines / employees (1994)	280	195	212	181	206
Investment / Sales (1994)	28.5%	19.2%	25.7%	29.4%	29.4%
Fixed assets / main lines (1994)**	3896	2495	2405	3681	4801

* Billions
** Thousands

Source: our elaborations on Stet data

Table 3 - Four Components of Performance

	Revenue-Cost Ratio	*Price Recovery*	*Product mix*	*Capacity utilisation*	*Productivity*
Telecom Italia					
1989	0.81	0.66	0.98	0.97	1.29
1990	0.81	0.64	0.99	0.98	1.32
1991	0.84	0.64	0.99	0.99	1.34
1992	0.89	0.64	1.00	1.01	1.38
1993	0.97	0.68	1.00	1.02	1.41
France Telecom					
1989	0.98	1.11	0.97	0.92	0.99
1990	1.01	1.09	0.97	0.93	1.02
1991	1.01	1.06	0.97	0.94	1.04
1992	1.00	1.02	0.98	0.95	1.07
1993	0.97	0.94	0.98	0.96	1.11
Deutsche Telekom					
1989	1.22	1.45	0.98	0.96	0.89
1990	1.15	1.30	0.99	0.98	0.92
1991	1.09	1.17	0.99	1.00	0.94
1992	1.09	1.12	1.00	1.01	0.96
1993	1.03	1.00	1.00	1.03	1.00
British Telecom					
1989	0.98	1.26	1.01	1.06	0.73
1990	1.00	1.19	1.01	1.07	0.77
1991	0.99	1.10	1.01	1.07	0.83
1992	1.01	0.98	1.01	1.05	0.96
1993	1.00	0.86	1.02	1.07	1.07
Telefonica					
1989	0.97	0.95	0.99	1.00	1.03
1990	0.99	0.95	1.00	1.01	1.04
1991	1.03	0.95	1.00	1.02	1.06
1992	1.03	0.92	1.00	1.02	1.09
1993	1.04	0.88	1.01	1.04	1.12

Table 4 - Price recovery

	Price Recovery	*Output price changes* $\Sigma_i p_i^t Y_i^t / \Sigma_i p_i^0 Y_i^t$	*Input price changes* $\frac{\Sigma_v w_v^t Q_v^t + \Sigma_F w_F^t Q_F^t}{\Sigma_v w_v^0 Q_v^t + \Sigma_F w_F^0 Q_F^t}$
Telecom Italia			
1989	0.66	0.89	1.35
1990	0.64	0.88	1.38
1991	0.64	0.90	1.40
1992	0.64	0.89	1.38
1993	0.68	0.89	1.32
France Telecom			
1989	1.11	1.01	0.90
1990	1.09	0.98	0.90
1991	1.06	1.03	0.97
1992	1.02	1.01	0.99
1993	0.94	0.98	1.04
Deutsche Telekom			
1989	1.45	1.11	0.76
1990	1.30	1.07	0.82
1991	1.17	1.03	0.88
1992	1.12	1.05	0.93
1993	1.00	1.01	1.01
British Telecom			
1989	1.26	1.17	0.93
1990	1.19	1.11	0.93
1991	1.10	1.05	0.95
1992	0.98	1.01	1.03
1993	0.86	0.97	1.13
Telefonica			
1989	0.95	0.90	0.95
1990	0.95	0.92	0.97
1991	0.95	0.96	1.00
1992	0.92	0.98	1.07
1993	0.88	0.93	1.05

Table 5 - A Synthesis

	Profitability	Productivity	Price Recovery	Product Mix	Capacity utilisation
France	0	+++	---	0	+
Germany	---	+++	----	+	++
Italy	+++	++	+	+	+
Spain	++	++	--	+	+
United Kingdom	+	++++	----	0	+

0 = no significant changes
+ = improvement
- = worsening

Figure 1 - Average Performance Trends

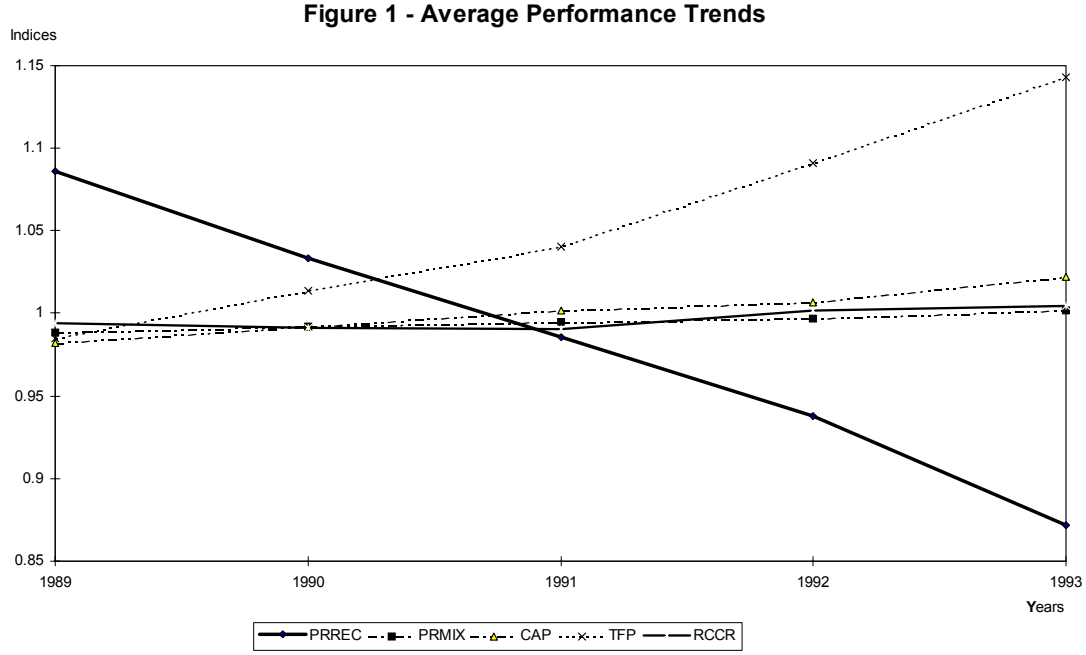
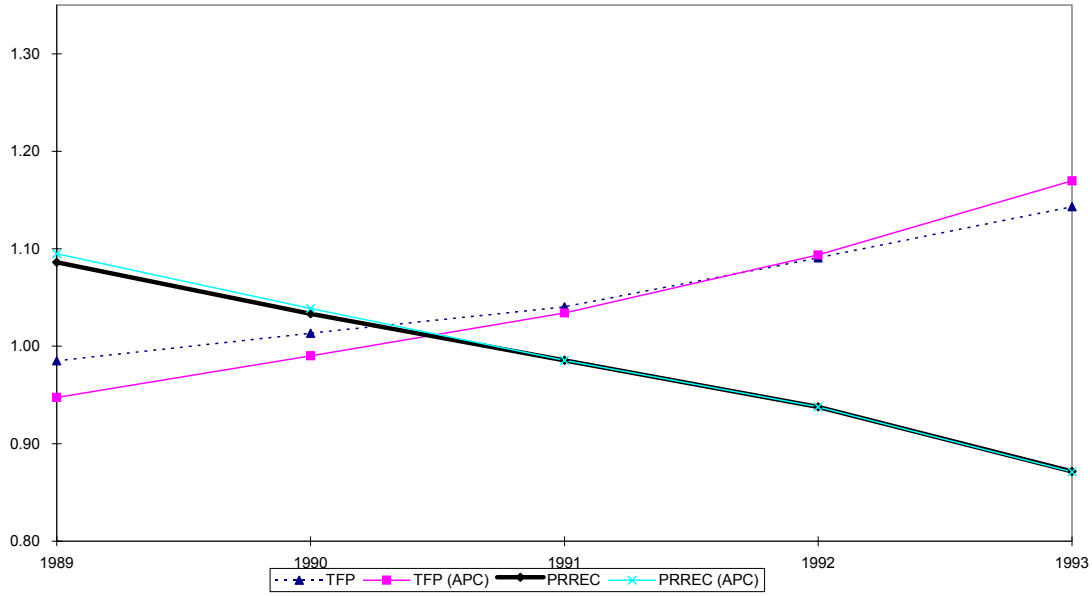


Figure 2 - Comparison with the APC method



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